

# SCIENCE.

FRIDAY, JUNE 3, 1887.

## COMMENT AND CRITICISM.

PROF. ARTHUR T. HADLEY'S thorough acquaintance with the railway problem puts it in his power to make a popular exposition of it that for clearness and conciseness is unrivalled. In *Harper's magazine* for June he outlines the progress of American railroad legislation. The Clinton league, the Granger movement, and the general railroad laws are touched upon, and their relation to each other shown. Then followed what may be called the period of state railroad commissions, that of Massachusetts being the example for nearly all the others. The state of affairs when the movement for a national railroad law became prominent, is characterized thus: "By the year 1880 it had become a well-established principle that it was impracticable to fix rates directly by law; that the important thing was to secure publicity and equality, and, above all, to have the means of holding the railroads responsible for what they did. On the other hand, the railroads had come to recognize, what ten years before they would have denied, that their business was not a purely private one; that they had public rights and responsibilities, and could not claim immunity from legislative control." Professor Hadley traces rapidly the genesis of the present Interstate commerce law, and in so far as it forbids preferential rates, provides for the publication of rates, and prohibits secret drawbacks, he unreservedly commends it. In its provisions as to local discrimination, however, and in its prohibition of pools, it is regarded as open to serious objection. But it is best regarded as a step to something wiser and better, as an experiment from whose failures a more perfect measure will be suggested. When this more perfect measure comes, it will doubtless, as Professor Hadley says, recognize the fact that railroad history plainly teaches that what we need is not so much a set of laws or regulations, but publicity and responsibility in railroad administration.

THE TRUSTEES of the Elizabeth Thompson science fund have made the following grants, of  
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which we have the pleasure of making the first public announcement: 1°. To the Natural history society of Montreal, \$200, for the investigation of underground temperatures by a committee of that society; 2°. To Dr. T. Elster and H. Geitel, instructors at the gymnasium of Wolfenbüttel in Germany, \$210, for researches on the electrization of gases by glowing bodies; 3°. To Prof. E. D. Cope of Philadelphia, \$500, for researches on American fossil vertebrates, the sum to be expended to secure the services of a skilled preparateur to assist in working out the material already accumulated for the continuation of Professor Cope's great work; 4°. To W. H. Perkin, jun., of Manchester, England, privat-docent at the University of Munich, Germany, \$250, for investigations on the synthesis of urea from its decomposition products; 5°. To Edward E. Prince of St. Andrews, Scotland, \$125, for the investigation of the development and morphology of the limbs of teleosts. It may be worth while to add, that these appropriations indicate that the trustees are inclined to make several appropriations of moderate amount rather than a single large one. It will be noted that no grant over \$500 has been made. This point may be of interest to intending future applicants.

## SEA-SICKNESS.

THE sensation of sea-sickness is one which has in one form or another been experienced by most persons, if not on the sea itself, at least while riding backward or in swinging. It is the dread of this rather than the fear of accident which deters many from undertaking a European tour, and it is therefore a question of great interest whether or not this experience may be avoided, and thus the principal obstacle to an ocean voyage be removed.

Although in most instances sea-sickness is but temporary, disappearing as soon as the affected individual places his foot on shore, still this is not always the case. In rare instances it has been the cause of death, and even when this has not been the case, the individual has been permanently affected. In many cases what is usually but an inconvenience and a disagreeable sensation becomes a disease which demands medical treatment on account of the violence of its symptoms. It is for

these reasons that physicians have made a study of sea-sickness, and have in various publications given the results of their investigations to the world.

In Quain's 'Dictionary of medicine' sea-sickness is defined as a peculiar functional disturbance of the nervous system, produced by shock, resulting from the motion of a ship. The most prominent symptoms are a state of general depression, giddiness, vomiting, and derangement of the bowels and of the urinary secretion. Dr. B. W. Richardson, in his 'Field of disease,' says that the phenomena of sea-sickness may be placed under the same head, in regard to cause, as concussions experienced by iron-plate workers who are employed in riveting, or by travellers on railroads. In sea-sickness the effect of the motion of the vessel is to produce a series of shocks to the ganglionic or organic as well as to the cerebro-spinal system. In some persons the organic nervous system is chiefly affected, and they suffer from vomiting and loss of appetite, and may remain prostrated for many weeks, and in one instance the sickness was never entirely recovered from during a comparatively long life; in others the shock tells most upon the brain and spinal cord. Such cases are less troubled with vomiting, but are oppressed with headache, giddiness, and inability to stand upright or move with steadiness. After they have completed the voyage, these persons suffer still from unsteadiness in walking, feeling, as they express it, the movements of the vessel. A repeated series of concussions, as it were, affected the brain so as to leave an impression of a wave-like motion, which does not subside until after a considerable length of time.

Various other theories have been held in regard to the causation of sea-sickness. Wollaston, who wrote on the subject in 1810, considered it due to sanguine congestion of the brain brought on by a deranged centre of gravity during the pitching forward of the vessel; Barru believed it to be owing to irritation of the optic nerves caused by the apparent vacillation of every thing around the vessel; Pellarin accounted for it by sanguine depletion in the brain caused by a centrifugal force called into action within the blood-vessels in consequence of the oscillation of the ship. In more ancient times Plutarch treated of the subject, and attributed sea-sickness to the smell of the sea and the fears of the patient.

Among those who have written treatises on the subject, we mention Dr. John Chapman as one whose treatment has been measurably successful. This writer gives it as his opinion that the main proximate cause of the affection is an undue

amount of blood in the spinal nervous centres, and especially in those parts of them directly related to the stomach and the muscles concerned in vomiting. The result of this hyperaemia is that the nerves emanating from the affected nervous centres partake of the undue activity of the centres themselves, and convey to their ultimate distributions an excessive amount of nervous impulses, which have the effect of disturbing the ordinary action of the organs supplied.

It will be seen from this brief consideration that there are many and various theories in regard to the causation of sea-sickness, and the number might be increased did space permit. As would naturally be expected, the methods of treatment are also various. Dr. Chapman recommended the application of ice, contained in rubber bags, to the spine, with the idea of overcoming the hyperaemic condition of the spinal cord, which he believed to be the cause of the symptoms. Some twenty years ago this plan of treatment was adopted by a considerable number of individuals, and remarkably favorable results were reported. Travellers crossing the Channel and making sea-voyages, who had previously suffered severely from sea-sickness, were by means of the ice-bag enabled to make their journeys with comfort, and freedom from sickness. In recent years we have heard but little of the ice-bags. Whether this is to be accounted for on the ground that on a fuller trial they failed to accomplish all that was claimed and expected, or whether the difficulty connected with their use was too great for them ever to come into general use, we do not know. In a recent letter to a daily paper a correspondent states that he has made twenty-six trips, or fifty-two tours, across the Atlantic, and has in every instance, except the last, suffered very much from sea-sickness. On this last trip he had with him a rubber bag, twelve inches long and four inches wide, the mouth of which was closed by an iron clamp. This he filled with small pieces of ice and applied to the spine at the base of the brain for half to three-quarters of an hour every morning. It had a most soothing effect, and he enjoyed every hour and every meal.

In a recent number of the *Boston medical and surgical journal* is a letter from William James of Harvard college, in which he says that whilst studying the feeling of dizziness, he was led to discover the singular immunity from it which deaf-mutes, as a class, possess, and he attributes this to the destruction either of the auditory nerves or of their labyrinthian termination. He found also in deaf-mutes what seemed signs of a possible immunity from sea-sickness, and ventured the suggestion that the semicircular canals

were probably the starting-point of that affection also, and that its symptoms in an ordinary sufferer might be alleviated by blistering or otherwise counter-irritating the skin around the ears. Later, in crossing the English Channel, he thought he prevented an attack of sea-sickness in himself by rubbing the mastoid processes with his fingers. He has since been unable to get any one to try the plan. He refers to an account of an accident which happened to the editor of the *Gulf review*, of Florida, as confirmatory of his views of the cause of sea-sickness. In this accident the editor received a blow on the mastoid process just behind the right ear, crushing the outer table of the skull, and destroying the delicate nervous portion of the internal ear, including the semicircular canals. The immediate consequences of the injury were, first, the most distressing nausea of a character identical with sea-sickness, which lasted, with intervals of ease, for two or three days; and, secondly, complete destruction of the function of the ear, being deaf in that ear ever after. Shortly after convalescence, the writer made a voyage to Cuba and back in rough weather, exposed to a very rough sea for six days each way, and, although previously very susceptible, he found himself proof against sea-sickness; and this immunity has continued ever since, now nearly twenty-eight years. Dr. James requests that travellers will bear his suggestion in mind, and report to him the result, whether successful or failures.

Dr. Fordyce Barker, an eminent physician of New York, and a traveller by ocean of great experience, has also suggested a method for the treatment of sea-sickness. He recommends that in making a short passage over rough water a hearty meal should be eaten not more than two or three hours before sailing, and that the individual should, if possible, keep in the centre of the vessel, and lie down before starting, and that he should avoid disagreeable sights and smells. In making ocean voyages, he should select his berth with these same objects in view, and should remain in bed for one or two days, and eat regularly and heartily. He should take a cup of coffee or tea each morning before rising, and should keep the bowels regulated. If diarrhoea sets in, it should be controlled by the remedies usually given for cholera-morbus. If the weather becomes rough, he should go to bed before becoming sick.

It may be of interest to note that a large number of remedies has been recommended from time to time, by physicians and others, for sea-sickness. Among them are the bromides of potassium and sodium, hydrate of chloral, opium, chloroform,

hydrocyanic acid, alcohol, nitrite of amyl, cocaine, strong coffee, Hoffman's anodyne, bismuth, bicarbonate of soda, and nitroglycerine; for external application, ice, stimulating liniments of belladonna, chloroform and camphor, and hot bottles to the feet. It is a safe principle in medicine that when, for any given disease, a large number of remedies is recommended, the specific remedy, or that which will cure all the cases of that disease, or the most of them, has not yet been discovered. The writer in Quain's dictionary says, on the subject of treatment, it may be premised that there is no known means of preventing sea-sickness in those susceptible of it. We should be glad to have the recommendation of Dr. James carried out, and to receive reports from those who, during the coming summer, may try his plan.

#### THE MEETING OF THE ECONOMIC AND HISTORICAL ASSOCIATIONS.

ON Tuesday morning, May 24, the Historical association listened to papers on 'A study in Swiss history,' by J. M. Vincent of Johns Hopkins university; 'The Spaniard in New Mexico,' by Gen. W. W. H. Davis; and 'The historic name of our country,' by Prof. Moses Coit Tyler of Cornell. The Economic association first heard the report of its committee on the 'Condition and organization of retail trade,' which was the subject of some discussion, and then Prof. Henry C. Adams read a report on 'Municipal public works.' The replies to the committee's circulars to gas companies were interesting.

Circulars were sent to 971 gas companies in the United States; and of these, 675 sent replies to various questions relative to price of gas per thousand cubic feet. The prices ranged all the way from 75 cents to \$20 a thousand feet. All over \$6 were considered so abnormal as to be put out of consideration. It was found that the average price of the coal-gas companies was \$1.73, that of water-gas \$1.85, and the total average \$1.75, per thousand feet. It was remarked, that, although the average cost of producing water-gas was not as great as that of the coal-gas, the price of the former was greater. This is due to the fact that popular ideas of relative danger and other circumstances did not warrant the production of the water-gas on so large a scale as the coal-gas companies are warranted in producing it.

The afternoon session was a joint one of both associations, and was held at Sander's theatre, Harvard university. Three papers were presented. The first, by Prof. E. J. James of Philadelphia, was on 'Our legal tender decisions,' and

was a defence of the last decision of the supreme court against the criticism of George Bancroft. Dr. A. B. Hart of Harvard read an amusing 'Biography of a river and harbor bill,' in which he traced the history of this bill for 1887 as an illustration of congressional methods and financial legislation. The paper by Col. Carroll D. Wright, on the 'Study of statistics in colleges,' was by many considered the most valuable of the meeting, and we are glad to learn that it will shortly appear in pamphlet form. Colonel Wright showed what Europe was doing in statistical studies, and paid a deserved compliment to Prof. Richmond M. Smith of Columbia for his work in this field. He pointed out the difficulty of applying statistics properly, and insisted on the necessity for trained statisticians. He would arrange the teaching of statistical science in three grand divisions: 1. The basis of statistical science, or, as it has been generally termed in college-work, the theory of statistics; 2. The practice of statistics, which involves the preparation of inquiries, the collection and examination of the information sought, and the tabulation and presentation of results; 3. The analytical treatment of the results secured. He remarked that our census could be more scientifically taken, could more of the subordinate workers be men who had had a statistical training.

The active work of both associations closed Tuesday evening. The closing papers before the Historical society were, 'The government of London,' by Prof. Arthur M. Wheeler of Yale university; 'Religious liberty in Virginia, and Patrick Henry,' by Charles J. Stillé, LL.D., of Philadelphia; 'The American church in history,' by Dr. Philip Schaff of Union theological seminary, New York; 'Brief report on historical studies in Canada,' by George Stewart, jun., president of the Historical society, Quebec. The following committee was appointed to urge congress to establish a national commission to collect and care for the manuscripts and documents relating to U. S. history: Justin Winsor, George F. Hoar, John Jay, Andrew D. White, Rutherford B. Hayes, Ainsworth R. Spofford, and President Dwight of Yale. The officers elected for the ensuing year were as follows: president, William F. Poole, Chicago public library; vice-presidents, President Charles K. Adams of Cornell, John Jay of New York; secretary, Prof. H. B. Adams, Johns Hopkins university; treasurer, Clarence W. Bowen, New York City; executive committee, Rutherford B. Hayes of Ohio, Prof. John W. Burgess of Columbia, Prof. Arthur M. Wheeler of Yale, and William Wirt Henry of Richmond.

The principal paper at the closing session of the

Economic association was by Prof. Frank J. Goodnow of Columbia, and was on the 'Administrative aspect of municipal franchises and finance in Europe and America.' The paper was an able study in comparative administrative law, and commanded the closest attention. It was discussed by Professor Johnston of Princeton, Professor James of Philadelphia, Mr. Giddings of Springfield, Mass., and others. Professor Ely read his report, which spoke most encouragingly of the society's prospects. The total membership is now over three hundred, and much interest is shown in the work, even in England.

Pres. Francis A. Walker of Boston, and Dr. Nicholas Murray Butler of Columbia, were appointed a special committee to report on the economic effects of industrial and technical education in the United States. The officers elected were as follows: president, Francis A. Walker; vice-presidents, Prof. Henry C. Adams, Prof. E. J. James, Prof. J. B. Clark; secretary, Prof. R. T. Ely; treasurer, Dr. E. R. A. Seligman. On Wednesday, the 25th, both associations made an excursion to Plymouth, and dined together at the Samoset house. The meeting was a most successful one, and the officers of the Institute of technology and of Harvard university did every thing in their power to render it enjoyable. It is proposed to hold the next meeting at Columbus, O., in September, 1888.

#### NEW ZEALAND LETTER.

THAT portion of the year which extends from May to October inclusive, is the busiest in this part of the world for politicians, university men, and members of scientific and literary societies.

In matters political, the question upon which public opinion in the colony is being most exercised, and around which parties are gradually crystallizing, is that of free trade *v.* protection. This also is the question which will probably prove the one of chief interest outside our own borders; and those who have borne their part in the long-continued struggle still being fought out in the states, will naturally feel more or less interest as they see these small but growing Australasian communities entering upon the same struggle. We have two noted examples before us in Victoria and New South Wales: the latter—free trade to the backbone—is apparently far outstripping its rivals in the race for wealth and progress. One aspect of the question, on which, however, it is pre-eminently difficult to frame an opinion, is as to which of the two communities enjoys the greatest amount of social peace and harmony, and in which is there the least amount

of misery arising out of their commercial relations. In this colony the majority of the manufacturers are already heavily protected by the customs duties—amounting in most cases to about sixteen per cent *ad valorem*—which it has been found necessary to levy for revenue purposes. Without such duties, many of the manufactures now established, notably those of cloth, blankets, woodware, etc., would be quite unable to exist. But those directly interested are by no means satisfied with the measure of protection already enjoyed, and are clamoring for more. The coming parliamentary session will probably be marked by a determined attempt to commit New Zealand to a protectionist policy.

The university colleges, of which three are now well established at Dunedin, Christchurch, and Auckland, with a fourth about to be started in Wellington, open their sessions for the year either this or next month. The Canterbury (Christchurch) and Auckland colleges hold two sessions of a little over three months each, with a break of a month between; while the University of Otago (Dunedin) has only one six-months' session, the classes adjourning for a fortnight's necessary rest in the middle. The idea in the latter, which is founded on the lines of the Scotch universities, was to enable the students to teach six months, and study six months. It is found that but few can avail themselves of this plan, and an attempt has recently been made to assimilate all the colleges to one plan; but for the present this has not met with success. The present premier, who is also minister of education, Sir Robert Stout, is endeavoring to specialize the work of the different colleges, in order to prevent too much rivalry and clashing of interests. Thus Otago already possesses a complete faculty of medicine with a full staff of professors and lecturers, and is authorized to grant degrees of M.B. and C.M. Last session there were medical students, and the number is increasing yearly. As the university of Edinburgh accepts work done in Dunedin as equivalent to that done by their own extra-mural teachers, it has hitherto been usual for the Otago students to take two or three years' study here, and then go to Edinburgh for their degree. Now, however, that the medical staff is complete, the number who graduate here will steadily increase.

Otago also possesses a school of mines in connection with her university; but this Sir R. Stout wishes to transfer to Christchurch, which already has in Sir Julius von Haast of the Canterbury museum, and Prof. F. W. Hutton, two men widely known for their geological researches.

The University of New Zealand, to which these colleges and a few of the larger secondary schools

are affiliated, is a somewhat anomalous body. It consists of a senate and convocation, endowed with powers to grant degrees and to manage their own internal affairs, and supported by a small annual grant from the government. But like the University of London, whose example it intended to follow, it has no teaching staff in direct connection with it, and, to suit the geographical conditions of the country, it is peripatetic, holding its annual session in one or other of the larger towns. Its headquarters for the time being will always be where its chancellor resides; and as that honorable position is held at present by Dr. Hector, the chief scientific adviser of the government, the seat of administration is in Wellington.

A vigorous effort has been put forth for the last two years to establish schools of mines in the principal mining-centres of the colony. Dr. J. G. Black, professor of chemistry in Otago university, is the leading spirit in this movement, which has been warmly supported by the government. Whether the attempt to popularize chemistry is altogether a wise one, in the way at any rate in which it has been done here, is a matter of opinion. Mere test-tubing, taught in a dozen lessons, will not convert a rough gold-miner into an expert mineralogist, yet this is too much the kind of thing which has been resorted to. In every mining-centre, large or small, testing-classes have been started, where hundreds of novices, destitute of the most elementary knowledge of chemical principles, are introduced to the art of the qualitative analysis of minerals. Whatever they learn, they don't get any scientific training. It is impossible, however, to deny that Dr. Black has exhibited immense enthusiasm and zeal in carrying out his plans; and if these result, as he hopes they will, in the ultimate establishment of properly equipped schools of mining, he will have achieved a noble work, in the success of which the earlier crude efforts will be forgotten.

There is immense room for improvement in methods of alluvial mining, and especially in the utilization of the fine gold of which so much is now lost. In the Laurence district of Otago, the famous Blue Spur cement, after being crushed and treated for gold, has been repeatedly washed; yet at the present day a considerable number of Chinese miners are still engaged turning it over and washing it, probably for the tenth time, and they make from eight to ten shillings a day, or more, at it.

An attempt to open up the West Coast sounds country this last summer has not been very successful. The dense forest vegetation and the generally inaccessible nature of the country have proved such difficulties that prospecting has been

greatly delayed. Until tracks fit for a horse to travel in have been cut through the bush, it will not be possible to open up this district, which in parts teems with mineral wealth. The excessive rainfall — which, however, has never been measured — makes life in that district rather miserable; while the hordes of bloodthirsty sandflies, which occur everywhere in the open country, tend at times to make it unendurable. G. M. T.

Dunedin, N.Z., April 20.

### HEALTH MATTERS.

#### *Ladies' health protective association.*

THE Ladies' health protective association of New York, which was incorporated in 1884, has published its report for the years 1885 and 1886. The particular business and object of this society are stated in the certificate of incorporation to be the protection of the health of the people of the city of New York by taking such action from time to time as may secure the enforcement of existing sanitary laws and regulations, by calling the attention of the proper authorities to any violations thereof, and to procure the amendment of said laws and regulations when they shall be found inefficient for the prevention of acts injurious to the public health. Any lady residing in the city may become a member of the association, and any gentleman may be admitted as an advisory member. One of the first nuisances attacked by the association was the manure-yard of Michael Kane at the foot of East 46th Street, in which large quantities of stable-manure were accumulated. Kane had been indicted four years before, but the nuisance still continued. Another complaint was made to the grand jury, and three ladies of the association were summoned before that body to testify. He was again indicted, and subsequently tried and convicted, and the manure entirely removed. During one of the visits of a committee, its members were attacked by a mob, which necessitated police escort in their future investigations. The attention of the association was next directed to the slaughter-houses of the city. In the annual report it is stated that three interviews were had with the board of health to obtain the co-operation of that body in an effort to remove the slaughter-houses from the city limits, or else to compel them to conform to proper sanitary regulations. Meeting with no encouragement, a bill was prepared and submitted to the legislature, providing for better regulations for the slaughter-houses. A public meeting was held to sustain this movement, at which Hon. Noah Davis, chief justice of the supreme court, presided. The bill did not pass the legislature,

but the efforts put forth by the association aroused the public attention and interest. In the following year the nuisance from accumulated manure again demanded interference. A bill was presented to the legislature, establishing a permanent dumping-ground between 95th and 97th streets and 1st Avenue and East River. Through the efforts of this association, the measure was defeated. The report states that the removal of stable-refuse, and its transportation through the city, are still subjects of annoyance and complaint, and that the ordinances limiting the hours and the manner of removal are continually disregarded. Efforts are being made to persuade railroad companies and others to bale the manure, and thus diminish the nuisance. The association has been informed by one of the large slaughterers of the city that he will build an *abattoir* which will be a model in every respect, and this is looked forward to as one method of lessening the nuisances connected with this business. The gas-works, and a section of the city known as 'Little Italy' between 5th and Madison avenues, east of Central park, have also engaged the attention of the members of the association. Examinations have also been made of numerous tenement-houses and schools. The association has demonstrated that a few determined persons, actuated by the public good, can accomplish a great deal in the way of reform, and we wish the association success in its work.

TYPHOID BACILLUS. — Dr. Sternberg has recently conducted some experiments as to the thermal death-point of the bacillus of typhoid-fever. A fresh culture of the organism was introduced into capillary glass tubes, which, after being hermetically sealed, were placed in a vessel containing water, and exposed to a constant temperature for ten minutes. At the end of this time the contents of these tubes are introduced into sterile flesh-peptone-gelatine contained in test-tubes. These are in turn placed in an incubating-oven, and exposed to a temperature of 20° to 22° C. If at the end of a week the organism has not developed, it may be taken for granted that it has been destroyed by the heat. After eight experiments of this kind, it was found that in no instance did the bacillus develop after it had been exposed to a temperature of 56° C., while in one experiment growth occurred after exposure to 55°. The thermal death-point of this bacillus may be safely placed at 56° C. (132.8° F.).

YELLOW-FEVER INOCULATION. — In 1885 and 1886, 6,524 persons submitted themselves to protective vaccination against yellow-fever in Rio

Janeiro. During these two years, 1,675 persons died from that disease; and of that number, 1,667 were unvaccinated, eight only of those who had received the treatment having died. This statement was made by Freire and others to the Academy of science. These gentlemen state, that, taking as the basis of their calculation the population exposed to the contagion, the percentage of deaths for the whole number was one per cent, whereas for those who had been subjected to preventive inoculations it was only one per thousand.

A THREE-YEAR TRANCE. — In the *Revue d'hypnotisme* is reported the case of a young lady who has been in an uninterrupted trance for nearly four years. In 1883 she received a fright, and shortly after had convulsions, from which she passed into a profound sleep which has continued to the present time. She takes food in small quantities. Dr. Bérillon, who reports the case, has, as the result of his examination, found the limbs wasted, and the fat of the body to have disappeared. Anaesthesia is complete. The pulse is very weak, and beats one hundred to the minute. The face is pale, waxy, and expressionless. She is totally unconscious, and cannot be aroused.

PURIFICATION OF SEWAGE. — L. P. Kinnicutt, professor of applied chemistry at the Worcester free institute, has recently given his opinion as to purification of the sewage of that city by means of chemical precipitation. In his report to the city engineer, he discusses the three general methods used for the purification of sewage, — irrigation, intermittent filtration, and chemical precipitation. That sewage can be purified in England by the system of broad irrigation, when the system is carefully carried out, there is no question. The amount of land required, however, is very great, probably an acre for every fifty persons. This, together with the cost of properly preparing the land, conducting the sewage thereto, and carrying the effluent away, makes the system a most costly one for a city of any size. Purification of sewage by means of intermittent filtration is an attempt to reduce the amount of land by applying the sewage intermittently, the amount of land being, as given by the most careful authorities, one acre to five hundred persons. The cost of preparing the land for this purpose is very great, as it must be deeply under-drained. The land, when used, is not well fitted for the production of crops, and the decomposition of the organic matter contained in the sewage depends almost entirely on the oxygen contained in the soil. The third method, chemical precipitation, consists in adding certain chemicals to the sewage, which precipitates practically all the suspended

matter, and which could undoubtedly be carried to a point where most of the offensive matter in solution was destroyed. The effluent obtained by this process can either be carried directly into a running stream, or first filtered through a small area of land. The recommendation of Professor Kinnicutt in reference to the best method for the purification of the sewage of Worcester is that chemical precipitation be adopted, with the addition of a small area of land, for possible use in very hot, dry weather; and, for every million gallons of sewage, the addition of about 900 pounds of quicklime for the neutralization of free acid, and 2,150 pounds in the form of milk of lime, or 1,000 pounds in the form of lime-water, for the precipitation process proper.

#### EXPLORATION AND TRAVEL.

##### Africa.

THE journal of Bishop Hannington, who was murdered in Uganda, contains some interesting notes on Masai Land, according to *Petermann's Mittheilungen* for May. His travels between the Victoria Nyanza and the Nile are important, as he was the first white man to visit that part of the country.

Count Teleki has organized an expedition to Central Africa, which left Zanzibar on Jan. 24, under the command of Lieutenant von Höhnel. The object of the expedition is the exploration of the Kilima Njaro.

Extracts from letters of H. M. Stanley, dated from the Kongo on March 20 and 21, are published in the *London Times*. The expedition arrived at Banana Point on March 18, after a pleasant and satisfactory voyage. Stanley chartered three small steamers belonging to the trading companies of the lower Kongo, and on March 20 and 21 the whole expedition was conveyed to Matadi. The expedition appears to be in a very satisfactory condition. A serious disturbance between the Zanzibari and Tippu-Tip's men on the one side, and the Sudanese on the other, was quickly suppressed; and Stanley says that later on perfect peace prevailed among the different elements composing the expedition. The news he received at Bomo from the committee in charge of the administration of the Kongo Free State was very discouraging. He was informed that a serious famine existed as far as Stanley Pool, and that the steamer Stanley is at present hauled up for repairs. Besides this, the Baptist mission refused to lend its steamer Peace to the expedition. Thus Stanley encounters numerous obstacles; but we may expect, nevertheless, to hear soon of his arrival at Stanley Pool.

As the Stanley relief expedition makes it unnecessary to send another expedition to the relief of Captain Casati, the Milan Società d'esplorazione commerciale in Africa has changed its plans, and has sent two of Tippo-Tip's men to Unyoro, bearing letters of credit for Casati to the missionary and trading stations on the route. Thus Casati will be enabled to return from Unyoro to Zanzibar, and it is probable that in this way Emin Bey will be informed of Stanley's attempt to reach him.

It is stated in *Petermann's Mitteilungen* for May that the German Reichstag has appropriated 150,000 marks (about \$36,000) for the continuation of explorations in Africa. While former appropriations were used for the expeditions of the German-African society, the government has resolved to use the present appropriation for the exploration of the German possessions in Africa. Lieut. R. Kund, the explorer of the Lukenye, will be sent to Kamerun, to penetrate from that point into the interior, which, on account of the hostility of the natives, has been hitherto inaccessible.

A. von Dankelmann has reduced the barometrical observations of R. Kund, and compared them with those obtained from the observations of von François, Dr. Büttner, and von Mechow. As stated in *Petermann's Mitteilungen*, he considers the height of Stanley Pool (900 feet) and of San Salvador (1,800 feet) reliable. The rivers Kuango, Kuilu, Sankuru, and Lukenye are from 1,050 to 1,300 feet above sea-level, the western rivers being the more elevated. This fact shows that these rivers run through an extensive plain, into which they have cut their beds.

#### *New Guinea.*

We learn from the Proceedings of the Royal geographical society for May that the government of Victoria is preparing to send out a well-equipped expedition to explore the Owen Stanley Mountains from Port Moresby, and has offered the leadership to the man of all others best able to carry so difficult an undertaking to a successful issue; namely, the Rev. J. Chalmers. A grant of ten thousand dollars has been made towards the cost of the expedition, and further contributions are expected.

#### *America.*

Chaffanjon writes from Ciudad Bolivar to the Geographical society of Paris (*Compt. rend.*, No. 9) that the success of his expedition to the sources of the Orinoco was complete. His companions, Indians from the Maquiritares and Bares tribes, were so much afraid of the Guaharibas, who inhabit the region about the head waters of the Orinoco, that he had the greatest difficulty in inducing them to follow him. He explored the

mountains of that region, and determined the positions of numerous places by astronomical observations. He is going to visit the sources of the Essequibo before returning to France.

The expedition of Dr. K. von den Steinen, before leaving the coast of Brazil, made some anthropological and ethnological researches among the Sambuquis in the province of Santa Catharina (*Gazette géogr.*, May 12). The company intended to start for the head waters of the Xingu on the 2d of May. Although ethnological studies are the main objects of the expedition, Messrs. Gervaiso Ninus Piris and Moreira de Silva have accompanied it for the purpose of making geological observations.

#### NOTES AND NEWS.

THE vessels of the U. S. coast survey are now located as follows: the *Bache* left Key West May 24, and arrived at New York last Tuesday, where she will fit out for work in Vineyard Sound; the *Gedney* left New York May 30 for work on the coast of Maine; the *Olympia* is now at work on the coast of Washington Territory; the *Endeavor* is now on the Louisiana coast, but will close its work this week and proceed to New York. Mr. F. W. Perkins, who has been on the steamer *Hitchcock* on the coast of Louisiana, has dismissed his party, and will be in Washington until June 15; Mr. J. H. Turner has been ordered to Salt Lake City, and will continue the work on the triangulation of the 39th parallel; Captain Bou-telle has gone to St. Paul, Minn., to organize a party under the direction of Professor Hoag of the University of Minnesota, for making a triangulation survey of the state. The work will begin between St. Paul and Fort Snelling.

—The American fisheries society began its annual session in Washington last Tuesday. There was a large attendance of the members. The following are the officers of the society: president, Dr. W. M. Hudson, Hartford, Conn.; vice-president, W. L. May, Fremont, Neb.; treasurer, E. G. Blackford, Brooklyn, N.Y.; recording secretary, Fred Mather, Cold Spring Harbor, N.Y.; corresponding secretary, W. A. Butler, jun., Detroit, Mich. Prof. W. O. Atwater of the Wesleyan university presented a paper on "The chemical changes produced in oysters in floating, and their effect upon their nutritive value." Mr. K. Ito, superintendent of the fisheries of northern Japan, spoke upon the methods of fishing in Japan as compared with American methods.

—The fifteenth annual session of the American society of mechanical engineers began in Washington on Tuesday, May 31, over seven hundred



members being present. The secretary, Mr. F. R. Hutton, presented the report of the council, which stated that through Mr. Stephen W. Baldwin the society had gained possession of much of the expert apparatus belonging to the late Mr. John C. Hoadley of Boston.

— The second field-meeting of the Indiana academy of science was held at Waveland, Montgomery county, Ind., May 19 and 20. The first day was devoted to the exploration of the rugged sides of Sugar Creek in the vicinity of 'Shades of Death.' In the evening, Dr. T. C. Mendenhall, president of Rose polytechnic institute, delivered an address on 'Weather-predictions.' The second day was devoted to an excursion to Pine Hills, a picturesque region along Sugar Creek. The evening exercises consisted of a general discussion of the natural history of the localities visited. Over thirty members were present. The meeting was in every way a success. The committees which made the arrangements are deserving of much credit for the way in which their arrangements were carried out. The next meeting will be held at Indianapolis late in December.

— The American institute of electrical engineers was organized at New York City on May 13, 1884. It was the intention of its founders to establish a national organization of high character, which should be in every respect worthy of the support of American electrical engineers. In order to enhance its usefulness to the electrical fraternity, a determined effort was made at the annual and general meetings just past, to purchase a building in New York City, which is to be, what the title of the society implies, the 'American institute of electrical engineers.' This movement has been under consideration for three years past, a standing committee having been previously appointed for the work during the first term of Pres. Norvin Green. Among the important features of the institute will be an electrical library and a museum, to which, if space permits, an experimental laboratory may be added. Suitable accommodations will be provided for council and general meetings and the entertainment of members and their guests, and the house will be open at all reasonable hours. The work already accomplished is shown by the contents of the three yearly volumes of Transactions. These, however, will be surpassed by the volume now in press, which completes the record of the institute up to May, 1887.

— In Bulletin No. 26, issued recently from the department of zoölogy and entomology of the Michigan agricultural college, on p. 6, a typographical error makes the proper proportion of

Paris green or London purple to water, for spraying apple-trees for the codling-moth, to be one pound of Paris green to two gallons of water; whereas the proportion should be one pound of Paris green or London purple to two barrels, or one hundred gallons, of water.

— We learn from the *Naturwissenschaftliche Rundschau* of May 21 that on May 3 and 4 the curves of the barographs at Berlin showed sudden changes of the atmospheric pressure which could not be accounted for by meteorological phenomena. This fact is of interest as being coincident with the Sonora earthquake. Von Bezold, who mentioned this matter in the Physical society of Berlin on May 6, calls to mind the fact that the eruption of Krakatoa on Aug. 27, 1883, was also accompanied by sudden changes of the atmospheric pressure in Europe.

— Porter & Coates announce a new edition of 'Amateur photographer,' with two new chapters on paper negatives and microscopic photography, by E. Waller, jun.

— Botanists owe Professors Farlow and Trelease a debt of gratitude for the publication of their bibliography of North American fungi in the May number of the *Harvard university bulletin*, just issued. It contains a list of such works on North American fungi (excluding the Schizomycetes as belonging rather to the department of medicine than to botany proper) as are of greater or less value to working botanists. It is the first list of the kind yet published, and will show that the general belief of those not specialists in this branch of botany, that little has been written on North American mycology, is by no means correct. It includes a very large number of papers of a popular and indefinite character relating to fungi not specifically named which are scattered through various agricultural, horticultural, and other journals; the entries are in all cases accompanied by brief descriptive notes, which adds greatly to the value of the list; it contains also, when procurable, the place and date of birth of the authors included in the list. The most prolific author noted is M. C. Cooke, whose papers, including those published with other persons, number 71; other prominent authors are J. B. Ellis (50), W. G. Farlow (31), and M. J. Berkeley (30). Probably the complete list will contain more than seven hundred entries, of which nearly one-half are given in the present instalment, which reaches the letter H.

— In *Science* for May 20, p. 481, first column, second line, 'phenomenon' should read 'phenomenon in Assyrian.'

## LETTERS TO THE EDITOR.

\*. "The attention of scientific men is called to the advantages of the correspondence columns of SCIENCE for placing promptly on record brief preliminary notices of their investigations. Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

### The occurrence of similar inventions in areas widely apart.

IN *Science* of May 20, Dr. Franz Boas has reviewed in a very courteous manner my plan of studying and exhibiting anthropological material, to which I am happy to make reply.

I think that Dr. Boas honors me overmuch in giving me the entire credit for a system which had taken possession of some men's minds before I was born. As your space will not allow an extended argument, I shall confine myself to general statements.

1. Whoever attempts to classify material must first have in his mind certain notions, ideas, or characteristics by means of which he will separate one object from another. These ideas let us call 'classific concepts.'

2. All curators of anthropological museums must recognize the following classific concepts: material, race, geographical areas, social organizations, environment, structure and function, and evolution or elaboration. Besides these, there are other minor concepts which enter into a more minute classification.

3. Every scientific anthropologist charged with a great collection has in his own mind decided the order in which these concepts should be considered in the distribution of material, and I consider this the greatest blessing to science. If all the museums in the world were arranged upon the same plan, only one set of philosophical problems could be considered, and the study would be correspondingly circumscribed. If, however, such a measure becomes necessary, I sincerely hope the plan will be that of the national museum at Washington. Let it be distinctly kept in mind that the only difference among curators is in the degree of prominence given to each concept.

4. There is another factor which enters into the arrangement of material, and that is those who are to study the material. For instance, there are archeologists, ceramists, musicians, technologists of many kinds, and students of war, religion, and the aesthetic arts, who desire to see, in juxtaposition, the specimens which they would study. On the other hand, there are ethnologists and sociologists who desire to see all that belongs to a consanguine race, or to a geographical area, in juxtaposition.

One of the most delightful *incentives technique* as the ruling concept is the great variety of intelligent people who can be brought into co-operation in the work. It seems that there is something for everybody on earth to do, and I attribute the phenomenally rapid growth, at little cost, of the national museum, to the great variety of minds that catch its spirit and are glad to work for it in their several spheres.

Now, in a museum properly constructed it is possible to arrange the cases in the form of a checker-board, so that by going in a certain direction the parallels of cases represent races or tribes or locations. By inspecting the same cases in a direction

at right angles to the former, the visitor may study all the products of human activity in classes according to human wants. At any rate, whatever the fundamental conception be, in any museum every thing should tend to enlist the sympathies and co-operation of the greatest diversity of mind.

Finally, as regards similarities in the products of industry of areas wide apart, I think Dr. Boas's suggestion about superficial similarities from unlike causes a very ingenious one, but it has nothing to do with the case. Except in a general way, his affirmation that similar effects proceed from different causes will hardly meet with acceptance, in the face of the axiom that 'like effects spring from like causes.'

In another place I have sought to show the gradations of similarities. Superficial, formal, or functional similarities in nature may spring from diametrically opposite motives, as in the case of mimicry. But according to the doctrine of chances, the possibility of similar effects diminishes with the complexity of the organization and the number of co-operating factors.

The perplexing question is this: Can these similarities be made to throw any light upon the migrations of men? The philosophical ethnologist is always in a 'double corner,' by reason of two interpretations of similarities. — the one arguing contact of some kind; the other, disconnected causes, whether similar or dissimilar it matters not.

I think it is a growing conviction that inventions of both customs and things spring from prior inventions, just as life springs from life, and that the sooner we recognize the fact that in the study of arts, institutions, language, knowledge, customs, religion, and races of men, we must always apply the methods and instrumentalities of the biologist, the sooner will our beloved science stand upon an immovable foundation.

There is a disposition to magnify the importance of museum specimens. The valuable thing about them is the knowledge we acquire concerning them. A museum is an encyclopaedia, with specimens instead of pictures. I hold, and would emphasize, the opinion that the explorer who goes among a people to study their entire creed and activity will do his work better by having in his mind the determination to bring each industry into comparison with the same activities in other times and places.

There is one thought which should always be borne in mind in considering the biological method of treating ethnological material. In the natural world some beings are monorganic, others are polyorganic. It is so in the history of human inventions, therefore in the arrangement of specimens there are things which must always appear in sets. No one should think of separating a suit of clothing, a full-rigged vessel, the entire outfit of the arrow-maker, potter, weaver, or other craftsman. Professor Putnam would not think of separating the entire contents of a mound. Each of these things mentioned is a polyorganic unit whose parts are just as much related as the parts of the human body.

In conclusion, it is but just to remark that during the two years in which I have had charge of the department of ethnology in the national museum, I have given no attention as yet to the west coast of America from California to Mount St. Elias. To this fact, and not to any fault in my system, must

be attributed the difficulty which Dr. Boas encountered in studying our material in comparison with his own from that region.

O. T. MASON.

Washington, May 30.

#### An American dialect society.

Referring to the letter by R. B. in *Science* of May 20, it is certainly possible to establish an American dialect society. Yet I believe it much the better way to have the work undertaken by the American philological association than to form a new society. In my opinion, the advance of philological science will be much more readily promoted by a combination of the various societies now existing than by the formation of others. Philology would be the gainer if the Oriental and Modern language associations could be united with the American under one control. The success of the American association for the advancement of science should teach that in union there is strength, and that a large society attracts not only more attention from the public, but brings to its meetings a much larger proportion, as I believe, of its own members. The work of a dialect society is so largely local in its character that it can best be done by a large number of persons. That such a work should be done needs little proof. The principal question is, By whom shall it be done?

S. C. DERBY.

Columbus, O., May 24.

#### The causation of consumption.

Within the last few years the attention of the medical profession has been more than ever turned to the consideration of the cause or causes of pulmonary consumption. The renewed interest in the etiology of this disease is owing to the discovery of the bacillus tuberculosis. This important event gave origin to two theories; the one holding that the only cause of consumption was the bacillus tuberculosis, and the other that the disease but furnished a *nidus* for the bacillus, and that hence its presence was not a cause, but an effect. This difference of opinion among physicians has not materially altered even to the present day; and, while the factors of the problem which give rise to this difference of opinion remain unsolved, it is savoring of dogmatism to say that it is decided that so and so is the cause of consumption.

As we proceed further in our investigation of the causation of consumption, we find the adherents of one theory placing great stress upon heredity, and, on the other hand, men of the highest authority and standing in the medical profession giving it as their opinion that there is no direct heredity other than that the child of phthisical parents starts in life with a small stock of vitality, and is thus rendered more liable to the invasion and the destructive influences of any and all diseases.

At the present state of the inquiry it seems somewhat too hasty to say just what the cause of pulmonary consumption may be; but it certainly appears that this cause is compound, being made up of at least three several elements: to wit, —

1°. The feeble vitality or resisting power with which the given organism enters upon life.

2° (a). The action of an environment upon this organism detrimental to the maintenance of a good general health; or (b) in some cases the existence of a state of debility after an acute disease.

3°. The organism thus influenced being exposed to the action of the bacillus tuberculosis.

The bacillus tuberculosis is so widely disseminated in the air we breathe, and distributed in the food we eat, that, were it the only or the main cause of consumption, we might expect the extermination of the human race within a few years.

We may plant corn upon unsuitable soil, and there will be no growth; we may plant it upon prepared soil and exclude the sunlight, heat, and moisture, and there will be no growth; and so the bacillus tuberculosis is deposited in the lungs of every one of us nearly every day, and yet it takes no hold upon the majority, because either the system is refractory to it, or our environment is such that it cannot develop.

JAMES P. MARSH.

Green Island, N. Y., May 30.

#### The equivalence in time of American marine and intracontinental tertiaries.

In a paper published in the May number of the *American journal of science*, Dr. C. A. White discusses the possibilities of correlating in detail the North American intracontinental and marine tertiaries, and refers to the identification by Prof. L. F. Ward of four species of plants from the tertiaries of the Mexican gulf border, with those found in the Laramie group. I am unable to refer to the report of Professor Ward, which has not yet reached this coast, and am therefore unaware whether the plants referred to are from the country east or west of the Mississippi River; but I would take this occasion to call attention again to the opportunities afforded for the establishment of such correlations, in north-western Louisiana, south-western Arkansas, and the adjacent portions of Texas and the Indian Territory, where the marine formations, still recognizable in detail by their characteristic shells, are indefinitely split up, both horizontally and vertically, into a maze of marine outliers and fresh and brackish water deposits, of the equivalence and continuity of which there can be no possible question. Among these, certain fresh-water deposits on the upper Red River in Louisiana are extremely rich in well-preserved leaves and fruits, of which a collection (deposited at the University of Mississippi at Oxford) was made by me in 1869. Among my publications setting forth these facts, I have, in a paper read at the Indianapolis meeting of the American association for the advancement of science in 1871, pointedly alluded to the probable original continuity of this 'Mansfield group' of Louisiana with intracontinental tertiaries, and the further probability, that, by means of remaining outliers, at least a chronological scale for parallelizing these formations might be established along the shallow connecting trough outlined by the cretaceous shore-lines. While my supposition that the cross-timbers of Texas were also of tertiary age, has since been disproved, I am not aware that any exhaustive examination of the region lying between the Red and Arkansas rivers in the Indian Territory has been made; yet it is there that such direct connection must have existed, if at all within tertiary times. The striking increase of the lignitiferous facies toward the north-western border of the Gulf tertiary area, culminating in the appearance of bands of fresh-water limestone at Mansfield and north-westward; the fan-like expansion, in Arkansas and Louisiana, of the older por-

tion of the narrow bands formed by the marine stages in Mississippi and Alabama; with a manifest north-westward trend of such deposits as are continuously traceable in north-western Louisiana, while the later stages are abruptly deflected to the south-west, — all points to a rapidly progressing elevation of the axial cretaceous trough, that may, or may not, have completely separated the interior from the Gulf waters before the beginning of the tertiary period. In any event, the region referred to appears to me to be a critical one, deserving of exhaustive examination in advance of many others that offer only a subordinate interest in comparison to the problem of the correlation of the intracontinental and the marine tertiary. E. W. HILGARD.

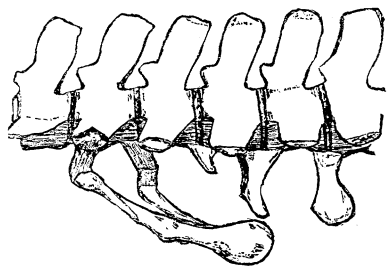
Berkeley, Cal., May 17.

### The pelvis of the dugong.

As far as I am aware, the pelvis of *Halicore australis* has never been properly described or figured.

Last fall I had the opportunity of examining, here at my father's establishment, six ligamentary skeletons, embracing both sexes, of this animal. A few hasty notes made at the time, and a section of vertebrae, including the pelvis (in which, unfortunately, the ischia have been torn asunder and separated from their haemapophysis), is all the material I can lay hands on, now that I have time to look the matter up: consequently my drawing and description cannot include a few points that I would wish.

In all six cases the fourth post-dorsal vertebra is the first sacral. The ilia are connected to the distal



ends of its diapophyses by short ligaments. The ends of these diapophyses are greatly swollen dorso-ventrally, their vertical diameter being thirty-three millimetres, whereas the preceding one measures but ten millimetres. The diapophyses of the two succeeding (sacral) vertebrae are also decidedly thicker at the ends than is the case in either the last lumbar or the succeeding caudals. Anchylosed to the ilia are the ischia lying in the same line, and showing their junction by a prominent swelling in the mass of the bone.

The distal ends of the ilia were connected with each other by a short ligament, and separated from the apex of the haemapophysis of the second succeeding vertebrae by but a few millimetres, connected to it either by a ligament or muscle, but which it is now too late to determine.

The ilium is 109 millimetres in length; the ischium, 102; the transverse diameter of its distal end, 46; the anterior-posterior length of the symphysis ischia, 34.

The first haemapophysis consists of two straight V-shaped bones 30 millimetres long, 29 millimetres

apart at bases, with points diverging to a distance of 51 millimetres. The next, to which the ischia join, has its two parts curving inward, leaving an oval opening, the extremities not quite meeting, and ligamentously connected. The succeeding haemapophyses have their ends anchylosed, and are V-shaped.

The point that I especially wish to emphasize is, that the pelvis is not *vertical* to the axis of the vertebral column, but lies at practically the same angle as ordinarily obtains in the mammalia.

In the six specimens examined, two had nineteen thoracic vertebrae, while four had but eighteen. All had three lumbar vertebrae. The thoracic are generally stated as being nineteen in number: with these this was the exception.

It is further to be noticed that the dugong appears to be an exception to the rule that when the number of thoracic vertebrae is increased or diminished there is a compensating diminution or increase in the number of lumbar vertebrae. HENRY L. WARD.

Rochester, N.Y., May 24.

### A cretaceous river-bed.

The springs at San Marcos, Hays county, Tex., where the San Marcos River rises full grown from the earth, with a steadiness of flow in marked contrast with the majority of Texas rivers, are, aside from their scientific aspects, sufficiently interesting to have been a subject of popular speculation and newspaper discussion ever since the settlement of Texas. The theories that have been advanced are various, from the popular idea that it is sufficiently explained by the presence of a cave full of water under the hill, to the explanation proposed by an imaginative newspaper editor, that the water comes underground from the Rocky Mountains.

I have not felt it necessary to familiarize myself with the details of this discussion, since, although my conclusions may be to some extent old, the proof is certainly new; for the general principle upon which it is based has been but recently announced by Mr. Robert T. Hill in the *American journal of science* for April (xxxiii. p. 29); namely, that there exists between the earlier cretaceous strata of Texas and the superimposed rocks a plane of 'non-conformity by erosion,' indicating an interval of emergence between the two periods of cretaceous rock formation.

The strata in the vicinity of San Marcos not only furnish a striking proof of the truth of this principle, but they become a key to whatever is mysterious in the origin of the San Marcos River.

The accompanying section roughly represents the rocks exposed by the San Marcos at its source.

No better stratigraphical landmark than the stratum *bb*, the *Exogyra arietina* marl, could be desired. The exposures at San Marcos are typical ones, containing an unusually large proportion of perfect bivalve specimens of *Exogyra arietina* R., besides the usual smaller quantity of *Gryphara Pitcheri*, etc. Its exposures are from fifty to one hundred feet above the river-level, and, in connection with the *Ostrea carinata* bed below, furnish conclusive proof that these rocks are of the Washita division of the *earlier* or Texas cretaceous; lacking, however, the uppermost members of that series.

In the little valleys back of the portion of the section marked *aa*, I found a conglomerate composed of fragments of the hard earlier limestones and

pebbles cemented with white limestone, and gradually changing upward into a firm, barren, homogeneous limestone.

This formation was in continuation of, or sometimes below, the horizon of the *Exogyra arietina* marl. Here, then, was the solution of the problem of the San Marcos. The rocks before me were of the later cretaceous, deposited upon the gravel and shingle which had formed the bed of a river during the period of emergence. They had choked up and rendered impervious the superficial layers of the river-bed, but doubtless left the lower gravel and sand beds in as good condition for carrying water as ever. To make the evidence complete, I found, on examination of the rock *aa*, which lies only a few feet above the river, that it is the soft limestone of the later cretaceous, containing numerous specimens of *Gryphaea laeviscula* R., — a fossil found in great abundance a short distance east and north of Austin, and there occurring at the top of the Austin limestone.

We have, then, the channel, and need only to account for the water to fill it. The Blanco River, in a westerly direction from San Marcos, is about fifteen miles distant. In the upper part of its course it is a running stream of considerable volume; but

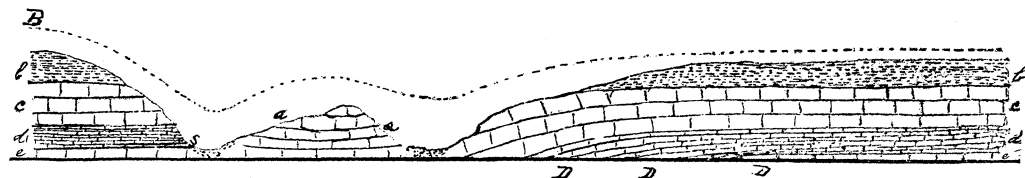
that the whole of the old bed is to some extent permeated by the waters of the underground river.

The extent and direction of this underground channel, and the determination of other streams than the Blanco which may be tapped by it, are promising subjects of future investigation, which I hope at an early date to undertake, not only in the hope of gaining, by a study of the amount of erosion of the older rocks, some idea of the duration of the interval between the two periods of rock formation, but of obtaining some information concerning the fresh-water life of that period. EDWIN J. POND.

Austin, Tex., May 18.

### Electrical phenomena at the Washington monument.

In various numbers of *Science* of recent dates have appeared notices of certain electrical phenomena experienced on western mountain-peaks. The peculiar effects experienced consist in general of a hissing or crackling sound accompanying single discharges, or a continuous flow of sparks, and the characteristic tingling sensation when a finger is presented to any metallic object near by. These experiences, despite the common belief, are not rare,



SECTION OF CRETACEOUS ROCKS AT SAN MARCOS, HAYS COUNTY, TEX., LOOKING SOUTH.

DDD, principal springs; B, hill upon which is the Chautauqua assembly building; aa, later cretaceous limestone, with *Exogyra laeviscula* R.; bb, *Exogyra arietina* marl; cc, firm limestone, with *Terebratulata Wacoensis* R. and *Pecten quadricostatus* Sowerby; passing into dd, thin-bedded soft limestone, with *Ostrea carinata* Law and numerous fossils of types *Ostrea*, *Gryphaea*, *Turritella*, *Pecten*, *Cardium*, *Cypricardia*, *Trigonia*, *Toxaster*, and *Ammonites*; ee, hard but broken limestone, with *Caprinas*.

below the point west of San Marcos it loses size rapidly, and at the point where the International and great northern railroad crosses it, and below, it is for the greater part of the year only a dry bed with occasional pools of standing water.

It has evidently cut through the overlying deposits, till it has reached the ancient bed of the San Marcos, which, thus filled with water, has been enabled to clear away whatever later deposits lay upon its ancient bed back to the present source of the San Marcos River.

To a geologist the question would at once occur, Why has not the current opened the whole of the old bed, and so caused the abandonment of the present bed of the Blanco long ago? The answer lies in the configuration of the older cretaceous strata at its present source. The old river had cut under what was the overhanging cliff of the hard limestone cc, causing it to dip abruptly, as represented in above section, and then found the least resistance in cutting a channel from the softer *Ostrea carinata* bed rather than in carrying away the fallen mass of the harder limestone. Hence the rocks of the old river-bed proper, at aa, though very soft, are protected from further erosion from beneath by the stratum cc.

There are, however, small springs at s, which show

nor confined to certain persons. At Pike's Peak these electrical manifestations are of frequent occurrence, and a list has been published (*Report of chief signal officer*, 1882, p. 893) showing the accompanying meteorological conditions in fifty-six instances, and proving that these electrical phenomena are closely connected with the occurrence of hail, snow, and thunder-storms. At these times it is easy to obtain sparks from woollen or fur garments, and to receive shocks on opening the door of the stove, or touching any metallic body. Again, at Fort St. Michael's (*Ibid.*, 1881, p. 768) during the coldest weather of winter, and always after a snow fog, "the air is so electrified that the hair upon any loose fur stands up, and a spark can be drawn by presenting a finger to the tip of a single hair."

In all these cases the observer may be considered as an insulated (perhaps, as in the case of one of your correspondents, he may stand upon a thick woollen Navajo blanket) body, which, because of the electrification of the air, acquires a charge. Contact with a body, in better, although perhaps not very good, connection with the ground, results in a discharge, with the described effects, varying in intensity with the degree of electrification. This condition of things is in part, I think, imitated in some experiments I have made at the top of the Washington

monument, during thunder-storms. The apparatus used consists of a large insulated collector, a modified Mascart electrometer, and Mascart insulators and the necessary adjuncts. As the thunder-clouds approach, the electrometer-needle becomes very active, and, after considerable oscillation, begins to move steadily in one direction (generally negative), until a deflection indicating, for example, a potential of three thousand volts, is reached, when, simultaneous with a flash of lightning, occurs a quick drop to zero, to begin again slowly to increase, and then more rapidly, until the next flash of lightning. So perfect is this correspondence, that the lightning can be timed as accurately from the indications of the electrometer as by direct vision. If at this time a finger be held out towards the collector, sparks are given, with the accompanying crackling and hissing, and the tingling sensation in the finger. In such a case, the observer is simply grounding the insulated charged collector. The greatest sparking distance, in our experience thus far, as determined by direct measurement, was a little under four millimetres. I have never found any difference (as one of your correspondents intimates) in the sparking distance, depending on the finger. The potential of the air, however, as shown by the electrometer readings, is constantly fluctuating, often very rapidly, and at certain times the potential of the air is zero. Of course, a finger presented at such a time, fails to draw a spark.

To imitate more closely the conditions of the mountain-side, the previous arrangement was reversed, and the observer insulated by standing on a Navajo blanket folded several times. This is but poor insulation, though it answered the purpose. Standing close to the open window of the monument, the results were as anticipated. My hair stood on end, and, on presenting a knuckle to the iron framework, a spark passed. I should remark that these effects were only experienced during a thunder-storm. I tried the experiment at other times, without success.

There are two further points of interest to which attention is called. Professor LeConte has instanced (*Science*, ix. No. 205) the case of the survey party on one of the San Juan mountains, where "a sudden cessation of the distressing electrical effects was experienced whenever there occurred a flash of lightning." This is confirmed by what precedes; and our electrometer readings make it certain that every lightning-flash relieves the electrical tension, and gives us also the means of estimating the electromotive force producing the disruptive discharge, and the electric strength of the air, under natural conditions. The second point of interest is the effect of electrification upon the water-particles present. Lord Rayleigh has shown how the character and direction of a fine stream of water may be altered by electrical influences; for example, a stick of sealing-wax, when rubbed, distorting a fine jet of water. Effects of the same character I noticed in the jet of water issuing from the nozzle of the collector. When the collector was 'grounded,' the stream would preserve a certain even, rounded character, breaking into drops some four inches away from the place of issue. Removing the ground connection, the stream would twist and split into sprays with the increasing electrification. Simultaneous with a flash of lightning, this distortion ceased, and for the moment the stream resumed its first character, only to be again distorted,

and repeat the same operation with the next lightning-flash.

ALEXANDER McADIE.

Cambridge, May 25.

### Railway jubilee, Paris, 1887.

I am requested by the executive committee in Paris to ask the favor of appealing through your columns for the loan of any objects, books, medals, drawings, etc., relating to the history of railways, and means of transportation generally, both ancient and modern, in this country.

I am directed, also, to say that all expenses of forwarding and returning the same to the lenders, packing and unpacking, will be defrayed by the executive, that each object will be insured for the value the lender may put upon it, and that special attendants will be told off for their safe custody.

All communications on the subject may be addressed to M. G. Senechal, 8 Faubourg Montmartre, Paris, or to Mr. George L. Fowler, M.E. (of New York City), commissioner in charge for the United States, Palais de l'Exposition, Bois de Vincennes, Paris, France. By addressing communications direct to Paris, much valuable time will be saved.

JOHN W. WESTON.

Chicago, Ill., May 23.

### The maxillo-palatines of *Tachycineta*.

With respect to what your correspondent says in regard to a drawing of mine, I can only say that the skull of *T. thalassina* from which it was made is a perfect one, and my copy correct in all particulars. This is more than I can say for the reproduction of it (*Science*, No. 223, fig. 1); but however this may be, it at least affords me now the opportunity to yield gracefully to my critic, for I am free to confess that the maxillo-palatines of that skull are 'imperfect' and 'broken off'—on paper—by Mr. F. A. Lucas; as any one may see who cares to compare my drawing in the Proceedings of the Zoölogical society of London (Dec. 1, 1885, p. 899, fig. F) with his copy of it in *Science*, to which I refer above.

R. W. SHUFELDT.

Fort Wingate, N. Mex., May 20.

### No parietal foramen in *Tritylodon*.

Dr. George Baur of the Peabody museum, New Haven, has been recently studying the fossil vertebrates in the British museum of natural history. At my request he has kindly made a careful study of the skull of *Tritylodon*, and finds that Professor Owen's observation of a foramen between the parietal bones is incorrect. He writes (London, May 8), "Ich habe *Tritylodon* hier genau untersucht, ein Parietal-Foramen existirt nicht; es ist wenigstens keine Spur desselben nachweisbar." This contradicts, without question, the suggestion I made in a recent number of *Science*, upon the strength of Professor Owen's observation, that there was probably a pineal eye of considerable size in *Tritylodon*. I hasten to make the correction, before the suggestion goes any further. Although it has proved incorrect, I think any one who will examine Professor Owen's figure and description of the *Tritylodon* skull (*Quart. journ. geol. soc.*, 1884) will admit that there was sufficient ground for this conjecture.

HENRY F. OSBORN.

Princeton, N.J., May 26.

# SCIENCE.—SUPPLEMENT.

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FRIDAY, JUNE 3, 1887.

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## ADVANCES IN METEOROLOGY.

DURING Mr. William Ferrel's service as a professor in the signal office for the past few years, from which he has recently retired, his chief occupation was the preparation of a work on meteorology that should represent the modern attitude of the science, and serve as a guide in the theoretical questions that continually arise in the prosecution of the practical studies of our weather-bureau. The book, originally intended to be a 'professional paper,' now appears as an appendix to the late chief signal officer's last report, published by authority of the secretary of war. This form of publication involves some inconveniences: the making of the book is not so good as such a book deserves; the current page-heading, 'Report of the chief signal officer,' is an unfortunate example of formality; but the matter of the book is a long way beyond that of any English work on the subject, and it will take and hold the place of a standard authority.

Its mathematical treatment of the subject carries it beyond most readers. A more popular work by the same author would be a boon to teachers and students alike, and would do more than this advanced treatise can, to correct the misconceptions that still prevail in most text-books, and to induce a consideration of deductive, dynamical meteorology as well as of inductive, statistical meteorology, that now takes so large a share of the scholar's time.

The problem of the general circulation of the atmosphere serves particularly well to illustrate the need of this change of view. It is, moreover, a subject in which Professor Ferrel holds a peculiarly high position.

Instead of attempting to review all of the 'Recent advances,' I shall therefore refer only to this great problem, whose successful solution illustrates the high value of our author's methods.

First, some thirty years ago, Ferrel made the initial steps towards its rational solution; and, with a single exception, there has been no one else working in this profitable field until a few of the European mathematical meteorologists lately entered it.

A short acquaintance with the study will suffice to show that the temperature, pressure, and motion of the atmosphere must be closely interde-

pendent. Difference of temperature, as between equator and poles, must bring about difference of pressure; difference of pressure will cause winds; and the winds would soon restore equilibrium, if the difference of temperature were not continually maintained. The equilibrium cannot be reached: the winds will flow in obedience to residual differences of pressure that they cannot reduce to zero as long as the sun shines.

The early attempts at the further solution of this problem generally led to the statements that the warmth of the torrid zone caused the equatorial belt of low pressure; that the cold of the polar regions ought to cause areas of high pressure there, which were somehow reversed into lower pressures than at the equator, especially in the antarctic regions; that the belt of high pressure around the tropics was due to the crowding of the upper winds as they overflowed from the equator north and south along the converging meridians. The trade-winds, and the anti-trades above them, were normal members of this general circulation; but the prevailing west-south-west winds of the north temperate zone, and west-north-west winds of the south temperate zone, were not so easily explained. Dove called them 'equatorial' winds, and saw the compensating return current in the occasional north-east or 'polar' winds, which are now known to be 'accidental' or cyclonic in origin, and quite apart from the general planetary circulation. Maury explained them by supposing a curious crossing of currents at the tropical belts of high pressure. In the torrid zone the equatorial overflow was aloft; but outside of the tropics it came down to sea-level, and the return current ran aloft, — a most arbitrary and unreasonable hypothesis. Views hardly more logical than these still prevail in many text-books. It is indeed now almost universal to ascribe the tropical belts of high pressure to the convergence of the meridians; though why the crowding of the air should disappear in higher latitudes, where the meridians converge faster, is not explained. Sprung calls attention, in his excellent '*Lehrbuch der Meteorologie*,' to the firm hold that this unphysical explanation has obtained, and wonders at the very slow awakening of meteorologists to Ferrel's theory. It is unfortunate that a theory so greatly needed has been so obscurely published. The *Nashville journal of medicine and surgery* first concealed it in 1856. *Runkle's mathematical monthly* gave it a more expanded

statement, but only carried it before a limited circle of readers, from 1858 to 1860. A briefer and more popular account appeared in the *American journal of science* in 1861, when school-masters might have seen it more generally, had not their attention been distracted by the war. Other brief articles have appeared in the same journal and in *Nature*. About ten years ago, an extended memoir, entitled 'Meteorological researches,' appeared as appendices to the coast-survey reports for 1877 and 1878, where they were said to be 'for the use of the coast pilot.' Like the earlier articles, these researches were too advanced and too little known to reach the school-master directly; but a review of them in *Nature* by Archibald has brought them before British meteorologists, where they were truly as much needed as with us. Still, it is only in Germany that they have had much effect on recent text-books, and it is to be feared that even the present work may not reach the readers who ought to have it: hence the hope expressed already, that Professor Ferrel may write a more popular book. We may hope, further, that it may find a way into our schools through some regular book-publishers rather than through dealers in second-hand government reports. Reflecting on this, how different was the immediate conquest of popular interest by Maury's famous 'Physical geography of the sea' from the long obscurity of Ferrel's 'Essay on the winds,' and how different the brief life of Maury's theories from the continually increasing vitality of Ferrel's! Perhaps, after all, the *Nashville journal* is a good medium of publication for the young scientist.

Ferrel showed in his first article, that, in consequence of the earth's rotation, all the atmosphere outside of the tropical belts of high pressure must have a general motion from west to east, and this disposed of Dove's north-east, 'polar' wind as a member of the planetary circulation. He also showed, that, as a consequence of the general eastward motion, the atmosphere would be drawn from the poles and thrown toward the tropics, thus causing the tropical belts of high pressure, and reversing the polar high pressure, that would be caused by the cold of the frigid zone, into polar low pressures. But, in order to explain the oblique recession of the surface winds in temperate latitudes from the tropics towards the poles, Ferrel then reversed the whole circulation of the winds at the tropics, placing the return current from the pole at the top, while it is at the bottom in the torrid zone.

The correction of this inversion appeared unconsciously and independently in a brief paper 'On the grand currents of atmospheric circula-

tion,' by Prof. James Thomson, read before the British association at Dublin in 1857. It occupies but little more than a page in the report of the meeting, and has never been expanded in the more complete form that it fully deserved. Thomson, like Ferrel, saw that the general motion of the atmosphere must be eastward, except in the trade-wind belt, and that the centrifugal force of the great polar whirls thus generated would decrease the pressure at the vortices or poles; but Thomson perceived also that the lowest part of the oblique return current, losing velocity by friction with the earth, tends to flow towards the pole, to supply the partial void in the central parts of the vortex. He states explicitly, "that, in temperate latitudes, there are three currents at different heights; that the uppermost moves towards the pole, and is part of a grand primary circulation between equatorial and polar regions; that the lowermost moves also towards the pole, but is only a thin stratum forming part of a secondary circulation; that the middle current moves from the pole, and constitutes the return current for both the preceding; and that all these three currents have a prevailing motion from west to east in advance of the earth." This was a most significant addition to Ferrel's first paper, but it lacked quantitative completeness. Ferrel's second paper modifies his first statements and diagrams, introducing the three-current system, and referring to Thomson's paper in a final paragraph, from which we may infer that the correction had occurred independently to our author. Be this as it may, Thomson's suggestion deserves more recognition than it has generally received. A second modification of the plan of general circulation appeared in the 'Researches' of 1877, in which the north-east winds of the arctic regions are omitted from the scheme of winds that would appear on a homogeneous earth, and thus by implication referred to a class that may be called continental, as depending directly and indirectly on the diversity of land and water surface on the globe: they are not known to occur around the south pole, where the surface is so largely water. Thus simplified, the scheme appears in the present work, where it demands the closest attention.

Another great generalization is that which connects cyclonic storms with the general circulation. It may be summarized as follows: a cyclone, or revolving storm, that appears in most symmetrical development in the tropical regions, has a centre of decidedly low pressure, surrounded by a ring of slightly higher pressure than the normal; outside of the ring, the surface winds move away from the centre and turn to the right of a radius; inside of the ring, the surface winds cir-



culate around the centre, blowing obliquely along an inward, ascending, left-handed spiral with increasing velocity, until they turn to an outward spiral aloft. The central low pressure in this case is primarily due to its high mean temperature, and secondarily to the centrifugal force of the whirl and the deflective force of the earth's rotation. This is a cyclone with a warm centre. The general winds of the northern hemisphere constitute a cyclone with a cold centre: their centre of low pressure is at the pole, and their ring of high pressure is around the tropic of Cancer, and, except for the lower member of surface winds, the currents approach the centre aloft, along a left-handed, inward, descending spiral, and turn to an outward spiral below. In this case, the pressure at the centre would be high, owing to the cold, were it not lowered by the centrifugal force of the whirl. In warm-centred cyclones, the steepest gradients and highest velocities are near the surface: in cyclones of cold centres, they are in the lofty regions. The enormous progress marked by such a generalization may be appreciated by reading the vague and vain theories of other authors. Ferrel's theory of tornadoes is another monument of deductive study, checked by a fulness of knowledge of fact, as far as observations and records allow.

It is not desired to imply by this reference to deductive methods that meteorological observations and their statistical study should in any way decrease: they are, of course, the essential foundation for further study. But it is a matter of regret that so few willing and interested observers go beyond this foundation-work far enough to discover the intense interest of the broader, physical study of meteorological phenomena. We may take pride in recognizing Espy and Ferrel as leaders in modern meteorology, but we must take care also that they have followers.

W. M. DAVIS.

#### HYPNOTISM IN FRANCE.<sup>1</sup>

THE voluntary production of those abnormal conditions of the nerves which to-day are denoted by the term 'hypnotic researches' has manifested itself in all ages and among most of the nations that are known to us. Within modern times these phenomena were first reduced to a system by Mesmer, and, on this account, for the future deserve the attention of the scientific world. The historical description of this department, if one intends to give a connected account of its development, and not a series of isolated facts, must begin with a notice of Mesmer's personality, and

we must not confound the more recent development of our subject with its past history.

The period of mesmerism is sufficiently understood from the numerous writings on the subject, but it would be a mistake to suppose that in Braid's 'Exposition of hypnotism' the end of this subject had been reached. In a later work I hope to show that the fundamental ideas of biomagnetism have not only had in all periods of this century capable and enthusiastic advocates, but that even in our day they have been subjected to tests by French and English investigators from which they have issued triumphant.

The second division of this historical development is carried on by Braid, whose most important service was emphasizing the subjectivity of the phenomena. Without any connection with him, and yet by following out almost exactly the same experiments, Professor Heidenhain reached his physiological explanations. A third division is based upon the discovery of the hypnotic condition in animals, and connects itself to the *experimentum mirabile*. In 1872 the first writings on this subject appear from the pen of the physiologist Czermak; and since then the investigations have been continued, particularly by Professor Preyer.

While England and Germany were led quite independently to the study of the same phenomena, France experienced a strange development, which shows, as nothing else could, how truth everywhere comes to the surface, and from small beginnings swells to a flood which carries irresistibly all opposition with it. This fourth division of the history of hypnotism is the more important, because it forms the foundation of a transcendental psychology, and will exert a great influence upon our future culture; and it is this division to which we wish to turn our attention. We have intentionally limited ourselves to a chronological arrangement, since a systematic account would necessarily fall into the study of single phenomena, and would far exceed the space offered to us.

James Braid's writings, although they were discussed in detail in Littré and Robin's 'Lexicon,' were not at all the cause of Dr. Philips' first books, who therefore came more independently to the study of the same phenomena. Braid's theories became known to him later by the observations made upon them in Béraud's 'Elements of physiology,' and in Littré's notes in the translation of Müller's 'Handbook of physiology;' and he then wrote a second brochure, in which he gave in his allegiance to Braidism. His principal effort was directed to withdrawing the veil of mystery from the occurrences, and by a natural

<sup>1</sup> Translated for Science from *Der Spinnz.*

explanation relegating them to the realm of the known. The trance caused by regarding fixedly a gleaming point, produces in the brain, in his opinion, an accumulation of a peculiar nervous power, which he calls 'electrodynamism.' If this is directed in a skilful manner by the operator upon certain points, it manifests itself in certain situations and actions that we call hypnotic. Beyond this somewhat questionable theory, both books contained a detailed description of some of the most important phenomena; but with the practical meaning of the phenomena, and especially with their therapeutic value, the author concerned himself but slightly. Just on account of this pathological side, however, a certain attention has been paid to hypnotism up to the present time.

In the year 1847 two surgeons in Poitiers, Drs. Ribaut and Kiaros, employed hypnotism with great success in order to make an operation painless. "This long and horrible work," says a journal of the day, "was much more like a demonstration in a dissecting-room than an operation performed upon a living being." Although this operation produced such an excitement, yet it was twelve years later before decisive and positive official intelligence was given of these facts by Broca, Follin, Velpeau, and Guérinau. But these accounts, as well as the excellent little book by Dr. Azam, shared the fate of their predecessors. They were looked upon by students with distrust, and by the disciples of Mesmer with scornful contempt.

The work of Demarquay and Giraud Teulon showed considerable advance in this direction. The authors, indeed, fell back upon the theory of James Braid, which they called stillborn, and of which they said, "*Elle est restée accrochée en route*;" but they did not satisfy themselves with a simple statement of facts, as did Gigot Suard in his work that appeared about the same time. Through systematic experiments they tried to find out where the line of hypnotic phenomena intersected the line of the realm of the known. They justly recognized that hypnotism and hysteria have many points of likeness, and in this way were the precursors of the present Parisian school. They say that from magnetic sleep to the hypnotic condition an iron chain can be easily formed from the very same organic elements that we find in hysterical conditions.

At the same time, as if to bring an experimental proof of this assertion, Lasigue published a report on catalepsy in persons of hysterical tendencies, which he afterwards incorporated into his larger work. Among his patients, those who were of a quiet and lethargic temperament, by simply

pressing down the eyelids, were made to enter into a peculiar state of languor, in which cataleptic contractions were easily produced, and which forcibly recalled hypnotic phenomena. "One can scarcely imagine," says the author, "a more remarkable spectacle than that of a sick person sunk in deep sleep, and insensible to all efforts to arouse him, who retains every position in which he is placed, and in it preserves the immobility and rigidity of a statue." But this impulse also was in vain, and in only a few cases were the practical tests followed up with theoretical explanations.

Unbounded enthusiasm and unjust blame alike subsided into a silence that was not broken for ten years. Then Charles Richet, a renowned scientist, came forward in 1875, impelled by the duty he felt he owed as a priest of truth, and made some announcements concerning the phenomena of somnambulism; and in countless books, all of which are worthy of attention, he has since then considered the problem from its various sides.

He separates somnambulism into three periods. The word here is used for this whole class of subjects as Richet himself uses it; viz., *torpeur*, *excitation*, and *stupeur*. In the first, which is produced by the so-called magnetic passes and the fixing of the eyes, silence and languor come over the subject. The second period, usually produced by constant repetition of the experiment, is characterized chiefly by sensibility to hallucination and suggestion. The third period has as its principal characteristics supersensibility of the muscles, and lack of sensation. Yet let it be noticed that these divisions were not expressed in their present clearness until 1880; while in the years between 1872 and 1880, from an entirely different quarter, a similar hypothesis was made out for hypnotic phenomena.

Jean Martin Charcot, the renowned neurologist of the Parisian Salpêtrière, without exactly desiring it, was led into the study of artificial somnambulism by his careful experiments in reference to hysteria, and especially by the question of *metallotherapie*, and in the year 1879 had prepared suitable demonstrations, which were given in public lectures at the Salpêtrière. In the following years he devoted himself to closer investigation of this subject, and was happily and skilfully assisted by Dr. Paul Richer, with whom were associated many other physicians, such as Bourneville, Regnard, Féré, and Binet. The investigations of these men present the peculiarity that they observe hypnotism from its clinical and nosographical side, which side had until now been entirely neglected, and that they observe patients of the strongest hysterical temperaments. "If

we can reasonably assert that the hypnotic phenomena which depend upon the disturbance of a regular function of the organism demand for their development a peculiar temperament, then we shall find the most marked phenomena when we turn to an hysterical person."

The inferences of the Parisian school up to this time are somewhat the following, but their results, belonging almost entirely to the medical side of the question, can have no place in this discussion. They divide the phenomena of hystero-hypnotism, which they also call *grande hystérie*, into three plainly separable classes, which Charcot designates catalepsy, lethargy, and somnambulism.

Catalepsy is produced by a sudden sharp noise, or by the sight of a brightly gleaming object. It also produces itself in a person who is in a state of lethargy, and whose eyes are opened. The most striking characteristic of the cataleptic condition is immobility. The subject retains every position in which he is placed, even if it is an unnatural one, and is only aroused by the action of suggestion, from the rigor of a statue to the half life of an automaton. The face is expressionless, and the eyes wide open. If they are closed, the patient falls into a lethargy.

In this second condition, behind the tightly closed lids, the pupils of the eyes are convulsively turned upward. The body is almost entirely without sensation, or power of thought. Especially characteristic of lethargy is the hyper-excitability of the nerves and muscles (*hyperexcitabilité neuromusculaire*), which manifests itself at the slightest touch of any object. For instance, if the extensor muscles of the arm are lightly touched, the arm stiffens immediately, and is only made flexible again by a hard rubbing of the same muscles. The nerves also react in a similar manner. The irritation of a nerve-trunk not only contracts all the small nerves into which it branches, but also all those muscles through which it runs.

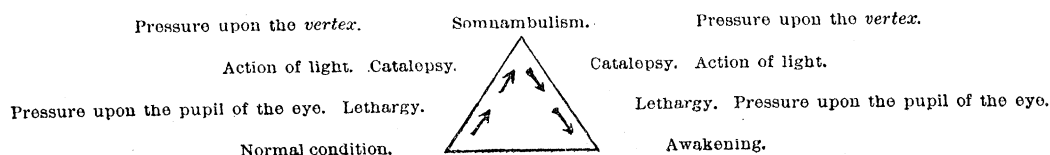
Finally, the somnambulist condition proceeds from catalepsy or from lethargy by means of a slight pressure upon the *vertex*, and is particularly sensitive to every psychological influence. In some subjects the eyes are open, in others closed. Here, also, a slight irritation produces a certain amount

of rigor in the muscle that has been touched, but it does not weaken the antagonistic muscle, as in lethargy, nor does it vanish under the influence of the same excitement that has produced it. In order to put an end to the somnambulist condition, one must press softly upon the pupil of the eye, upon which the subject becomes lethargic, and is easily roused by breathing upon him. In this early stage, somnambulism appears very infrequently.

Charcot's school also recognize the existence of compound conditions, the history of whose symptoms we must not follow here. These slightly sketched results, as well as a number of other facts, were only obtained in the course of several years; yet in 1882 the fundamental investigations of this school were considered virtually concluded. Then Dumont-pallier, the head of the Parisian Hospital pitié, came forward with a number of observations, drawn also exclusively from the study of hystero-hypnotism, and yet differing widely from those reached by the physicians of the Salpêtrière. In a long series of communications, he has given his views, which have in their turn been violently attacked, especially by Magnin and Bérillon. I give only the most important points.

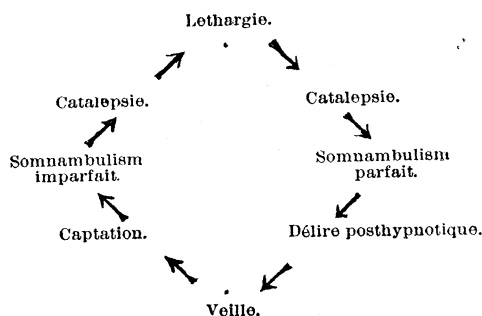
According to these men, the hyper-excitability of the nerves and muscles is present not only in the lethargic condition, but in all three periods; and in order to prove this, we need only apply the suitable remedy, which must be changed for each period and every subject. Slight irritations of the skin prove this most powerfully. A drop of warm water or a ray of sunshine produces contractions of a muscle whose skin-covering they touch.

Dumont-pallier and Magnin accede to the theory of intermediate stages, and have tried to lay down rules for them with as great exactness as Charcot's school. They also are very decided about the three periods, whose succession does not appear to them as fixed; but they discovered a new fundamental law which regulates the production as well as the cessation of the condition, — *La cause qui fait, défait*; that is, the stimulus which produces one of the three periods needs only to be repeated in order to do away with that condition. From this the following diagram of hypnotic conditions is evolved: —



And, furthermore, Dumont-pallier should be considered as the founder of a series of experiments, for he was the first one to show in a decisive manner that the duality of the cerebral system was proved by these hypnotic phenomena; and his works, as well as those of Messrs. Bérillon and Descourtis, have brought to light the following facts: under hypnotic conditions, the psychical activity of a brain-hemisphere may be suppressed, without nullifying the intellectual activity or consciousness; both hemispheres may be started at the same time in different degrees of activity; and also, when the grade is the same, they may be independently the seat of psychical manifestations which are in their natures entirely different. In close connection with this and with the whole doctrine of hemi-hypnotism, which is founded upon these facts, stands the phenomena of thought-transference, which we must consider later.

As an addition to the investigations of Charcot and Dumont-pallier, Dr. Brémaud, in 1884, made the discovery that there was a fourth hypnotic state, 'fascination,' which preceded the three others, and manifested itself by a tendency to muscular contractions, as well as through sensitiveness to hallucination and suggestion, but at the same time left to the subject a full consciousness of his surroundings, and remembrance of what had taken place. Descourtis, in addition, perceived a similar condition in the transition from hypnotic sleep to waking, which he called *délire posthypnotique*, and, instead of using the word 'fascination' to express the opening stage, he substituted 'captation.' According to him, the diagram would be the following:—



This whole movement, which I have tried to sketch, and whose chief peculiarity is that it considers hypnotism a nervous malady, and one that must be treated clinically and nosographically, was opposed in 1880 in two directions, — one source of opposition producing great results, while the other fell to the ground. The latter joined

itself to the theory of the Mesmerists, and tried, by means of exact experiments, to measure the fluid emanating from the human body, — an undertaking which gave slight promise of any satisfactory result.

Baillif in his thesis (1878), and Chevillard in his (for spiritualists) very interesting books, tried, by means of various arguments, to uphold the fluidic explanation. Despine also thought that by its help he had been able to explain the phenomena; but it was Baréty who, in the year 1881, first turned general attention in this direction. According to him, mankind possesses a nerve-force which emanates from him in different kinds of streams. Those coming from the eyes and fingers produce insensibility to pain, while those generated by the breath cause hypnotic conditions. This nerve-force goes out into the ether, and there obeys the laws that govern light, being broken into spectra, etc.

Claude Perronnet has more lately advanced similar views, and his greatest work is now in press. Frederick W. H. Myers and Edmund Gurney sympathize with these views, and try to unite them with the Mesmerist doctrine of personal influence, and their theory of telepathy. The third champion in England of hypnotism, Prof. Hack Tuke, on the contrary, sympathizes entirely with the Parisian school, only differing from them in that he has experimented with satisfactory results upon healthy subjects. In France this view has lately been accepted by Dr. Bottey, who recognizes the three hypnotic stages in healthy persons, but has observed other phenomena in them, and vehemently opposes the conception of hypnotism as a malady. His excellently written book is particularly commended to those who wish to experiment in the same manner as the French investigator, without using hysterical subjects.

The second counter-current that opposed itself to the French neuropathologists, and produced the most lasting impression, is expressed by the magic word 'suggestion.' A generation ago, Dr. Liébault, the patient investigator and skilful physician, had endeavored to make a remedial use of suggestion in his clinic at Nancy. Charles Richet and others have since referred to it, but Professor Bernheim was the first one to demonstrate its full significance in the realm of hypnotism. According to him, suggestion — that is, the influence of any idea, whether received through the senses or in a hypersensible manner (*suggestion mentale*) — is the key to all hypnotic phenomena. He has not been able in a single case to verify the bodily phenomena of *grandehypnotisme* without finding suggestion the primary cause, and on this account denies the truth of the asserted physical causes.

Bernheim says that when the intense expectance of the subject has produced a compliant condition, a peculiar capacity is developed to change the idea that has been received into an action as well as a great acuteness of acceptation, which together will produce all those phenomena that we should call by the name of 'pathological sleep,' since they are only separable in a gradual way from the ordinary sleep and dream conditions. Bernheim is particularly strenuous that psychology should appear in the foreground of hypnotism, and on this point has been strongly upheld by men like Professors Beaunis and Richet.

The possibility of suggestion in waking conditions, and also a long time after the sleep has passed off (*suggestions posthypnotiques ou suggestions à longue échéance*), as well as the remarkable capacity of subjects to change their personality (*changement de la personnalité, objectivation des types*), have been made the subject of careful investigation. The voluntary production of bleeding and stigmata through spiritual influence has been asserted, particularly by Messrs. Tocachon, Bourru, and Burot. The judicial significance of suggestion has been discussed by Professor Liégeois and Dr. Ladame. Professor Pitres in Bordeaux is one of the suggestionists, though differing in many points from the Nancy school.

This whole tendency brings into prominence the psychical influence, while it denies the production of these results from purely physical phenomena, endeavoring to explain them in a different manner. These explanations carry us into two realms, the first of which has been lately opened, and at present seems to abound more in enigmas than in solutions.

*Metallotherapie*, which was called into existence by Dr. Burg, and further extended by Dr. Gellé, contains a special point of interest, — the so-called transference in the case of hysterically or hypnotically affected persons. Transference is caused by electro-magnetism, which has this peculiarity, — that in the case of specially sensitive persons it can transfer the bodily affection from left to right, and *vice versa*. The transference of paralysis, the cures attempted on this plan, and the so-called 'psychical transference,' which contains special interest for graphologists, are at the present time still open questions, as well as the closely connected theory of human polarity; and the odic experiments of Dr. Chazaraïn are yet waiting for their confirmation. At present the problem of the connection between magnetism and hypnotism is under investigation, and in such a manner that we may hope for a speedy solution.

Still stranger than these reports, are the accounts of the distant operation of certain bodies;

at least, they seem strange to those unacquainted with psychometry and the literature of the past century relating to this subject. Two physicians in Rochefort, Professors Bourru and Burot, in treating a hystero-epileptic person, found that gold, even when at a distance of fifteen centimetres, produced in him a feeling of unbearable heat. They continued these experiments with great care, and, after a number of trials, came to this conclusion, that in some persons certain substances, even when carefully separated from them by long distance, exercise exactly the same physiological influence as if introduced into their organism. In order to explain these phenomena, they refer to the radiating force of Baréty, an explanation neither satisfactory to themselves nor to others. Lately the distinguished Parisian physician, Dr. Luys, has confirmed by his experiments the existence of these phenomena, but he thinks the explanation referable to hyper-sensitiveness of the "*regions émotives et intellectuelles de l'encephale*," yet even he has not reached the kernel of the difficulty.

In close connection with action at a distance is the question of distant production of hypnotic sleep. For an answer to this problem, they are experimenting in both France and England; and Frederick W. H. Myers has thrown an entirely new light upon the subject by the investigations he is making upon a purely experimental basis. In Italy they have limited themselves to the study of isolated cases of hystero-hypnotism, except as the phenomena of magnetic fascination investigated by Donato have given rise to further research; but all the books I have seen upon this subject, as well as many by French authors, suffer from ignorance of the latest English discoveries.

With this I think that I have given a slight outline of the history of hypnotic investigation to the end of the year 1886. I shall attempt a criticism of this whole movement at some other time, as space is not afforded to me here; but I should like to make this statement now, that two of the characteristic indications of this period are of the gravest import, — first the method ("Our work," says Richet, "is that of strictly scientific *testing, observation and arrangement*"); and, secondly, the result. Hypnotism has been received into the realm of scientific investigation, and with this the foundation of a true experimental psychology has been laid. MAX DESSOIR.

#### WALCOTT ON THE CAMBRIAN FAUNAS.

In a recent English geological work there occurs the remark, that, "in spite of the excellent work done by many American geologists, the true se-

quence of their oldest fossiliferous rocks still remains to be determined." The reason of this uncertainty is not far to seek: it lies in the exceedingly complex arrangement of these rocks along the Atlantic seaboard of the United States, where till lately they had alone been studied. Now, however, this reproach is beginning to be taken away from us, and one of the most valuable contributions to the solution of the problem is given by Mr. Walcott in the paper before us.

In the introduction the stratigraphical relations of the Cambrian rocks in Vermont, New York, various parts of Canada, Nevada, Utah, and Arizona, are described and illustrated with sections, and this part of the work is of peculiar interest. The great development of these rocks in the west, and their almost undisturbed position, render them of the utmost importance in deciphering the early history of the continent. Especially is this true of the region of the great Colorado Cañon in Arizona, where is found an immense thickness of unaltered strata which Mr. Walcott considers to be of pre-Cambrian age. The elucidation of its fossils will be awaited with great interest by all biologists as tending to bridge over the great gap between the archæan and paleozoic eras.

Mr. Walcott's studies lead him to the same results reached by the English geologists; namely, the division of the early paleozoic series (omitting the supposed pre-Cambrian) into three systems, — the Cambrian, Ordovician (lower Silurian), and Silurian (upper Silurian). On this head Mr. Etheridge remarks, "The recognition of a tripartite grouping of the faunas and strata between the base of the old red sandstone and the Harlech series cannot be disputed: each is characteristic and possesses a broadly marked aspect or facies." In the Cambrian system Mr. Walcott recognizes three series, — a lower, middle, and upper, — which correspond respectively to the St. John's group, the lower and upper Potsdam of Sir William Logan. The lower Cambrian fauna is not known to occur west "of a line passing north-east through eastern Massachusetts, New Brunswick and Newfoundland;" being kept out of the internal basin, Mr. Walcott believes, by a barrier extending from Lake Superior south to Texas, and west to Arizona. The middle Cambrian fauna would seem to be peculiar to America, not being represented in Wales, Scandinavia, or Bohemia: its nearest representative in Europe is on the island of Sardinia. If these results are confirmed, a great advance will be gained.

Most of the paper is taken up with a systematic

*Second contribution to the studies of the Cambrian faunas of North America.* (U.S. geol. surv., bull. No. 30.) Washington, Government. 8°.

account of the middle Cambrian fauna of North America, by far the most complete yet given. Forty-two genera (three of them new) and ninety-six species, of which sixteen are new, are fully described and figured. Especially interesting are the curious archeocyathoid sponges, which have so many features recalling certain paleozoic corals, the remarkable primitive pteropods, Hyolithes and its allies, the oldest known cystidean, and the great series of trilobites (fifteen genera). Mr. Walcott has accomplished much with fragmentary material, but the *morphological* results of the study of these early faunas are not very promising.

A gratifying aspect of this paper is its substantial confirmation of Emmons's work on the Taconic system, — a work which must ever excite admiration when its difficulties are considered. "Dr. Emmons deserves great credit for the work that he did. Struggling under adverse circumstances, at a time when there was almost nothing known of the pre-Potsdam strata of North America, and when geologic methods were yet in their beginnings, he accomplished a work in one of the most complicated regions of American geology, the central idea of which . . . we now know to be correct."

It should be remembered that in this paper Mr. Walcott has given a study, and not a complete and final expression of his views. Only a beginning has been made in a great undertaking, but it would be difficult to exaggerate the value of the work already done, which now offers a series of well-defined questions for solution, instead of the chaos which reigned but a few years ago.

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TRICHINÆ have been discovered in a human body which was being prepared for anatomical demonstration at the University of Camerino. The man had lived for many years in a neighboring commune, and died without the presence of the trichinae being suspected. Peculiar interest attaches to the case for the reason that it is said to be the first case of trichinosis ever observed in Italy.

— Professor Poncet of Lyons recently had under his care a man whose tibia had been broken and had failed to unite. Between the ends of the broken bone he attached the half of the first joint of a great toe, taken from a limb which had just been amputated. The piece thus attached formed adhesions, at one end fibrous and at the other bony. Whether the bone thus strengthened was of use, the report does not state.